CHAPTER 1

INTRODUCTION

1.1 The Problem Considered.

The energy consumption rate of the world is so great that it is certain that the supply of the fossil fuels will be depleted with in the next century. During the last few years, men have been searching to harness alternative sources of energy to be substituted for the fossil fuels. Among these, solar energy looks very promising since it is readily available in huge amount and has no known polluting effects upon the environment when converted into other forms for utilization.

Nowaday, refrigeration plays significant role in human society. It is used for preservation of food and medicine. It provides controlled temperature and humidity atmosphere for human comfort or for industrial processes. Absorption refrigeration cycle appears to be suitable for using solar radiation as heat source. There are two types of absorption refrigeration systems, namely the continuous and the intermittent cycle. The continuous one requires many mechanical components but gives continuous cooling effect while the intermittent machine gives periodic cooling. Its main advantages are the lack of mechanical component, simple system, low cost and long maintenance interval. These are the reasons for choosing the intermittent system for this study.

There are many plublished works on intermittent absorption unit. Trombe and Foex[1] reported some preliminary experiments with a pilot plant using the ammonia-water system. Williams, Chung, Lof Fester and Duffie[2] described a comprehensive investigation which included theoritical estimation of the performance of four different binary systems (methanol-siliga gel, acetone-siliga gel, ammonia-water and Freon 21-tetraethylene glycol dimethyl ether), and experimental study of two of these systems. In both the above investigations, the heat source was solar radiation focussed on to the generator by means of a reflector.

Eisenstadt, Flanigan and Farber[3] studied and reported on the ammonia-water system for solar cooling with solution concentration varying from 0.4 to 0.7 and with a maximum generator temperature ranges from 140 to 180 F.

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[1] Trombe, F. and Foex, M. Economic Balance Sheet of Ice Manufacture with an absorption machine utilizing the sun as the heat source Paper S/109 UN conference of New Sources of Energy (1961)

[2] Williams, D.A., Chung, R., Lof, G.O.G., Fester, D.A., and Duffie, J.A. Refrigerating Engineering, 66, 33 (Nov. 1958)

[3] Eisenstadt, m., Flannigan, F.M., and Farber, E.A. Solar airconditioning with an NH_3-water absorption refrigeration system. Engineering Progress at University of Florida, Technical Progress Report, 14, No. 2, 22-28 (1960)

Chinnappa[4] reported about the efficiency of a refrigeration using both the ammonia-lithiumnitrate system and the ammonia-water system. The auther gave detailed calculations of operations of both system, (without solar heating).

An ammonia-sodiumthiocyanate system was tested by Chung[5] et. al for solar refrigeration in the laboratory. From a 20 pound steel cylinder containing 12 pounds of the solution of approximately 1:1 by weight of ammonia and sodiumthiocyanate, 9 pounds of ice were produced per cycle. The author did not give any detailed information describing the performance of his intermittent absorption.

Beckman[6] proposed a theoretical performance of an ammonia-sodiumthiocyanate intermittent absorption refrigeration cycle. Swartman[7] also studied the ammonia-sodiumthiocyanate refrigerator by using a flat plate collector as a generator-absorber. The author shows that the NH_3-NaSCN refrigerant-absorbent has better performance than NH_3-H_2O refrigerant.

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[4]Chinnappa, J.C.V. "Experimental Study of the Intermitting Vapour Absorption Refrigeration Cycle Employing the Refrigerant-Absorbent System of Ammonia-Water and Ammonia-Lithium Nitrate," J. Solar Energy Sci. and Eng. 5,1 (1961).

[5]Chung, r., and Duffie,J.A. "Cooling with Solar Energy," Paper S/82 presented at UN conference on New Sources of Energy(1961)

[6]Beckman, W.A. "Theoritical performance of an ammonia-sodiumthiocyanate intermittent absorption refrigeration cycle. Solar Energy 12, 137-146 (1968)

[7]Swartman,R.K.,"Comparison of NH_3-NaSCN" J.Solar Energy,17, (1975)

1.2 Purpose of the present investigation.

The purpose of the present investigation are:

i) To study the performance of an intermittent absorption solar refrigeration system using NH_3-NaSCN.

ii) To compare the actual cycle to the theoretical intermittent absorption cycle.

iii) To compare the results with that of the existing data on NH_3-$LiNO_3$ and NH_3-H_2O systems.

iv) To determine the best practical concentration for intermittent refrigeration system (NH_3-NaSCN).

Notation

c	specific heat of NH_3-NaSCN solution
c_m	specific heat of NH_3-NaSCN solutions over a temperature range
H	enthalpy of solution
H_v	enthalpy of liquid ammonia
L_m	mean latent heat of ammonia
L_{dm}	mean differential heat of evaporation of ammonia
P	pressure
Q_c	effective cooling
Q_s	heat supplied to solution during regeneration
t	temperature of solution
W	mass of solution
X_a	concentration of solution, mass of absorbent per unit mass of solution
X_r	concentration of solution, mass of refrigerant per unit mass of solution
X_v	concentration of vapour, mass of refrigerant per unit mass of vapour
W	incremental change in solution mass
t_n	temperature rise of the solution during which the incremental change in solution mass is W
C	concentration (light)
COP	coefficient of performance = Q_c / Q_s

A_{nm}	projected area of parabolic solar collector
A_t	surface area of target which recieves the reflect light
D	diameter of collector
d	diameter of target
n	relative aperture
f	focus length
α	angle